

What is claimed is:

- 1) A composition having enhanced thermal and electrical conductivity, comprising, in combination a:
  - powder having average particle sizes in the nanometer to micron size range;
  - coating imparted to the powder particles; and
  - carrier medium selected from the group of carrier fluids, monomers, interpolymers, polymers, and phase change materials.
- 5) The composition of claim 1, wherein the coating further comprises a coating capable of acting as at least one of imparting composition stabilization, corrosion resistance and acting as a dispersant.
- 10) The composition of claim 2, wherein the coating acts as dispersant of the powder in the carrier medium by at least one of increasing settling time of the powder, passivating the powder, reducing interfacial tension of the powder and increases adhesion to the powder.
- 15) A process for transferring heat between a heat source and a heat sink, comprising the step of interposing between the heat source and the heat sink a heat transfer composition comprising a surface-coated powder, the coating imparting improved thermal conductivity properties to the powder relative to uncoated powder.
- 20) The process of claim 4, further comprising including the step of suspending the coated powder in a heat transfer medium.
- 25) The process of claim 4, wherein the surface-coated powder is prepared by one of:
  - complexing a coating compound with powder particles;
  - adsorbing a coating compound on surfaces of the powder particles; and
  - imparting a metal coating onto surfaces of powder particles and subsequently complexing the metal coating with another coating.
- 30) The process of claim 4, wherein the coating compound is in sufficient amount to form at least a molecular monolayer of the coating compound on surfaces of the powder particles.
- 8) The composition of claim 1 wherein the powder further comprises an average particle size of less than 10 microns.
- 9) The composition of claim 8 wherein the powder further comprises an average particle size within the range of 10 nm to 2  $\mu$ .

- 10) The composition of claim 1 wherein the powder is selected from the group of metal, metal alloy, organic metal compounds, inorganic metal compounds, carbon and combinations thereof.
- 11) The composition of claim 10 wherein the powder is selected from the group of metals consisting of copper, titanium, nickel, beryllium, iron, silver, gold, alloys thereof, blends thereof, and compounds thereof.
- 5 12) The composition of claim 10 wherein the powder is selected from the group of carbons consisting of graphite, carbon nanotubes, diamond, fullerene carbons of the general formula  $(C_2)_n$ , where n is an integer of at least 30, and blends thereof.
- 10 13) The composition as claimed in claim 1 wherein the carrier medium is selected from the group consisting of solids, fluids, and phase change materials.
- 14) The composition as claimed in claim 1 wherein the carrier medium is an interpolymer.
- 15) The composition of claim 14 wherein the interpolymer is prepared by polymerizing alpha-olefin monomer with vinylidene aromatic monomer and aliphatic vinylidene monomers with a volume ratio between 10:1 to 1:100 and a weight percent of 99 to 1 percent.
- 15 16) The composition of claim 15 wherein the interpolymer is further prepared with polymerizable ethylenically unsaturated monomer.
- 17) The composition of claim 13 wherein carrier medium is selected from the group consisting of conjugated polymers, crystalline polymers, amorphous polymers, epoxies, resins, acrylics, polycarbonates, polyphenylene ethers, polyimides, polyesters, acrylonitrile-butadiene-styrene (ABS); polyethylene, polypropylene, polyamides, polyesters, polycarbonates, polyphenylene oxide, polyphenylene sulphide, polyetherimide, polyetheretherketone, polyether ketone, polyimides, polyarylates, styrene, poly(tetramethylene oxide), poly(ethylene oxide), poly(butadiene), poly(isoprene), poly(hydrogenated butadiene), poly(hydrogenated isoprene),
- 20 25 liquid crystal polymers, polycarbonate, polyamide-imide, copolyimides precursors, reinforced polyimide composites and laminates made from said polyimides, polyphenylated polynuclear aromatic diamines, fluorocarbon polymers, polyetherester elastomers, neoprene, polyurea, polyanhydride, chlorosulphonated polyethylene, ethylene/propylene/diene (EPDM) elastomers, polyvinyl chloride, polyethylene terephthalate, polyvinylchloride, ABS, polystyrene, polymethylmethacrylate, polyurethane, polyacrylate, polymethacrylate, and polysiloxane, aromatic copolyimide, polyalpholefins, polythiophene, polyaniline,
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- polypyrrole, polyacetylene, polyisocyanurates, and derivatives thereof, vinyl monomers, styrene, vinyl pyridines, N-vinyl pyrrolidone, vinyl acetate, acrylonitrile, methyl vinyl ketone, methyl methacrylate, methyl acrylate, 2-hydroxyethyl methacrylate, 2-hydroxyethyl acrylate; polyols, ethylene glycol, 1,6-hexane diol, 1,4-cyclohexanedicarbinol, polyamines, 1,6-hexamidine, 4,4'-methylenebis (N-methylaniline), polycarboxylic acids, adipic acid, phthalic acid, epoxides, ethylene oxide, propylene oxide, and cyclohexene oxide, polyalkylene glycols, polyethylene glycol, polypropylene glycol, vinyl polymers, polystyrene, polyvinyl acetate, polyvinylpyrrolidone, polyvinylpyridine, polymethyl methacrylate, organic liquid-soluble polysaccharides, functionalized polysaccharides, cellulose acetate, and crosslinked swellable polysaccharides.
- 10 18) The composition of claim 16 wherein the carrier medium further comprises a phase change medium selected from the group consisting of salt-hydrates, organic eutectics, clathrate-hydrates, paraffins, hydrocarbons, Fischer-Tropsch hard waxes, inorganic eutectic mixtures, acetamide, methyl fumarate, myristic acid, Glauber's salt, paraffin wax, fatty acids, methyl-esters, methyl palmitate, methyl stearate, mixtures of short-chain acids, capric and lauric acid, coconut fatty acids, propane and methane.
- 15 19) The composition of claim 10 wherein the coating is selected from the group consisting of azoles, benzotriazole, tolytriazole, halogen resistant azoles, and substituted derivatives thereof.
- 20 20) The composition of claim 19 wherein the azole is selected from the group comprising of aromatic azoles, diazoles, triazoles, tetrazoles, benzotriazole, tolyltriazole, 2,5-(aminopentyl) benzimidazole, alkoxybenzotriazole, imidazoles, such as oleyl imidazoline, thiazoles, such as mercaptobenzothiazole, 1-phenyl-5-mercaptopentetrazole, thiadiazoles, halogen-resistant azoles, 5,6-dimethyl-benzotriazole; 5,6-diphenylbenzotriazole; 5-benzoyl-benzotriazole;
- 25 5-benzyl-benzotriazole and 5-phenyl-benzotriazole, a combination of alkoxybenzotriazole, mercaptobenzothiazole, tolyltriazole, benzotriazole, a substituted benzotriazole, and/or 1-phenyl-5-mercaptopentetrazole, a mixture of a pentane-soluble imidazoline, a pentane-soluble amide, a pyridine-based compound, a pentane-soluble dispersant, and a solvent, and combinations thereof.
- 30 21) The composition of claim 10 wherein the coating further comprises an inorganic corrosion inhibitor compound.

- 22) The composition of claim 10 wherein powder is a carbon powder and the coating further comprises a lignin-based compound, ethylene oxide/propylene oxide (EO/PO) block copolymers, anionic surfactants, ionic surfactants and nonionic surfactants.
- 23) The composition of claim 10 wherein powder selected from the group of aluminum and
- 5       aluminum alloys and the coating further comprises a cerium compound.
- 24) The composition of claim 10 wherein the powder is selected from the group of copper, silver, iron, steel and alloys thereof and the coating is selected from the group of mercapto-substituted thiodiazoles, amino-substituted thiodiazoles, and mercapto-substituted triazole, amino-substituted triazoles, oleyl imidazoline, triethanolamine and monoethanolamine.
- 10      25) The composition of claim 22 wherein the lignin-based compound further comprises at least one of a monovalent salt of lignin, free acid lignin, polyvalent metal salts of lignin, lignin sulfonic acid, alkali metal salts of lignin sulfonic acid, alkaline earth metal salts of lignin sulfonic acid, and ammonium salts of lignin sulfonic acid.
- 15      26) The composition of claim 10 wherein the powder is a carbon powder and the coating is selected from the group of alkali metal salts, alkali earth metal salts, ammonium salts, and alkyl ether phosphates.
- 20      27) A process for transferring electrons between cathode, an electron source, and anode, an electron sink, comprising the step of interposing between the cathode and anode an electrically conductive composition comprising a surface-coated powder, the coating imparting improved electrical conductivity properties to the powder relative to uncoated powder.
- 28) The process of claim 27, further comprising the step of suspending the coated powder in an electrically conductive medium.
- 29) The process of claim 27, wherein the surface-coated powder is prepared by one of:
- 25       – complexing a coating compound with powder particles;
- adsorbing a coating compound on surfaces of the powder particles; and
- imparting a metal coating onto surfaces of powder particles and subsequently complexing the metal coating with another coating.
- 30) The process of claim 27, wherein the coating compound is in sufficient amount to form at least a molecular monolayer of the coating compound on surfaces of the powder particles.
- 31) A powder having enhanced thermal and electrical conductivity, produced, in combination a:

- powder precursor having average particle sizes in the nanometer to micron size range produced by a process step selected from the group of solubilized, dispersed, emulsified, grinded, spray atomized and vaporized;
  - coating imparted to the powder precursor particles; and
- 5      - reaction medium selected from the group of solvents, fluids, monomers, interpolymers, polymers, and phase change materials.
- 32) The powder of claim 31, wherein the coating imparted to the powder precursor particles further comprises a coating capable of acting as at least one of imparting composition stabilization, corrosion resistance and acting as a dispersant.
- 10     33) The process of claim 32, wherein the surface-coated powder precursor is prepared by one of:
  - complexing a coating compound with powder precursor particles;
  - adsorbing a coating compound on surfaces of the powder precursor particles; and
  - organometallic chemistry.
- 15     34) The powder of claim 31, wherein the powder is prepared with in situ complexing of coating compound on powder precursor particles.
- 35) A in situ complexing of coating compound on powder precursor particles is prepared by one of:
  - microemulsions and chemical reduction of pre-complexed metal salts;
  - microemulsions and reduction of pre-complexed metal salts using sonochemistry;
- 20     - sonochemistry using high or ultrahigh frequency acoustic wave generation of cavitation in reaction vessel for reduction of pre-complexed metal salts;
- 25     - sonochemistry using high or ultrahigh frequency acoustic wave generation of cavitation onto plating surface through plating by electroless deposition of pre-complexed metal salts;
- 30     - sonochemistry using high or ultrahigh frequency acoustic wave generation of cavitation onto plating surface through plating deposition by electrolysis of pre-complexed metal salts;
- sonochemistry using high or ultrahigh frequency acoustic wave generation of cavitation onto plating surface through plating deposition by electrolysis of pre-complexed metal salts using high frequency electrical power source;

- submicron atomization of pre-complexed metal salts in liquid carrier with in situ chemical reduction;
  - submicron atomization of pre-complexed metal salts in liquid carrier with in situ electrochemical reduction;
- 5      - submicron atomization of pre-complexed metal salts in liquid carrier within vessel with voltage potential between atomizer and cathode;
- plasma processing of powder precursor with quenching in liquid carrier having pre-solubilized complexing coating compound;
  - combustion synthesis processing of powder precursor with quenching in liquid carrier having pre-solubilized complexing coating compound;
- 10     - pre-complexed powder precursor dissolved in supercritical fluid with in situ chemical reduction;
- pre-complexed powder precursor dissolved in supercritical fluid with in situ electrochemical reduction;
- 15     - electrolysis of pre-complexed metal salts using high frequency electrical power source on anode and cathode;
- electrolysis of pre-complexed metal salts using electrically conductive material selected from group of electrolyte or conductive polymer;
  - high pressure hydrogen chemical reduction reaction of powder precursor in liquid carrier having pre-solubilized complexing coating compound;
- 20     - high pressure hydrogen chemical reduction reaction of powder precursor in liquid carrier having pre-solubilized complexing coating compound in combination with high or ultrahigh frequency acoustic wave generation of cavitation in reaction vessel;
- high pressure hydrogen chemical reduction reaction of powder precursor in liquid carrier having pre-solubilized complexing coating compound in combination with high or ultrahigh frequency electromagnetic force generation in reaction vessel;
- 25     - cryogenic embrittlement in combination with processes selected from the group of high pressure hydrogen embrittlement, or high | ultrahigh frequency acoustic wave generation of cavitation in reaction vessel; or

- electrodialysis of pre-complexed metal salts in combination with processes selected from the group of high pressure hydrogen embrittlement, or high | ultrahigh frequency acoustic wave generation of cavitation on cathode.

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